MECHANICAL ENGINEERING SEMINAR

Monday, January 27, 2025 at 14:30, D. Dan and Betty Kahn Building, Room 217

Online: https://technion.zoom.us/j/91092630011

THERMOCHEMICAL EXHAUST HEAT RECUPERATION AS A PATHWAY TO HIGHER EFFICIENCY OF HEAT ENGINES

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The Applied Thermal Engineering Laboratory at the Guangdong Technion – Israel Institute of Technology was established in 2022 with the main goal of studying energy conversion in fuel-consuming equipment and the associated problems in thermodynamics, heat and mass transfer, and combustion. The primary focus is on investigating promising ways to improve energy efficiency – specifically, thermochemical exhaust heat recuperation – while also emphasizing the use of carbon-free fuels, such as ammonia.

In the first part, I will describe the concept of thermochemical exhaust heat recuperation (TCR) and my background in this topic, particularly its application in industrial furnaces and gas turbines fired with methane. A step-by-step solution will be presented, covering the journey from idea and concept through thermodynamic analysis and heat-mass transfer to pilot setup and industrial application.

In the second part, I will focus on specific results related to gas turbines with thermochemical exhaust heat recuperation – specifically, the chemically recuperated gas turbine (CRGT). This section will include schematic diagrams of CRGT and combined cycle power plants with CRGT, as well as discussions on thermal and exergy efficiency, heat, and mass transfer in the steam methane reforming process, focusing on transport phenomena within porous catalysts.

In the third part, I will present the current and future research in my laboratory aimed at utilizing ammonia in gas turbines and developing a compact and efficient fuel reformer based on Triply Periodic Minimal Surfaces (TPMS). When ammonia is used directly as gas turbine fuel, it suffers from low combustion efficiency. The use of TCR is expected to improve thermal and combustion efficiency of ammonia-fed gas turbines. The thermochemical transformation of ammonia is an endothermic and catalytic process that requires an external heat supply for the reaction. Therefore, developing a compact and efficient reformer is an important task, and we are focusing on solutions that utilize TPMS-based structures such as Schwartz-P, Neovius, Schoen, etc.

Seminars Coordinator: Assoc. Prof. Shmuel Gal.